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A color and life-history polymorphism in *Drosophila sulfurigaster*.

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The species of the *nasuta* species subgroup (*immigrans* species group) are highly similar and are best identified using karyotyping (Wilson *et al.*, 1969), although three groups are distinguished based on the coloration of the frons (the area between the eyes). *D. kohkoa*, *D. kepulauana*, *D. nasuta, D. albomicans* and *D. niveifrons* have a white patch on the frons. The various subspecies of the *D. sulfurigaster* complex and *D. pulaua* have white orbits, while the remaining species—*D.* taxon F, *D.* taxon I, *D.* taxon J and *D. pallidifrons*—do not have white on the frons (Wilson *et al.*, 1969; Kitagawa *et al.*, 1982; Kitagawa, 1991; Yu *et al.*, 1999). The coloration is more pronounced in males, but under the right light conditions, this character is also visible in females of *D. sulfurigaster*, though less obvious. Despite many studies, the taxonomy of the group is still not fully known (see Yu *et al.*, 1999; Nagaraja *et al.*, 2004; Bachtrog, 2006), while the assignment of species and subspecies status varies between authors (see Yu *et al.*, 1999).

Three representatives of this group, *D. sulfurigaster* (white orbits), *D. kohkoa* and *D. kepulauana* (both entire white frons), are found in the Philippines; of these, only *D. sulfurigaster* has been recorded from the north of Luzon (Baltazar, 1991; Bächli, 1999-2007; Ruiz-Fiegalan, 2004). In October 1994, I collected *Drosophila* in the Sierra-Madre Mountains, near Cabagan, Isabela province in the northern Philippines. Individuals belonging to the *D. nasuta* subgroup were assigned to two groups based on the absence or presence of the whitish to silvery lines on the frons along the eyes. One group clearly resembles *D. sulfurigaster*, while the second group did not fit the known species of the Philippines ('Type A'). No individuals with a whitish to silvery sheen on the entire frons were found, confirming the absence of *D. kohkoa* and *D. kepulauana* from the north of Luzon (Baltazar, 1991; Bächli, 1999-2007; Ruiz-Fiegalan, 2004).

D. sulfurigaster is a generalist species, collected in three habitats (grassland, forest edge and secondary forest), while 'Type A' is only found in the secondary forest. The distance between the collection sides in the secondary forest and in the forest edge was less than one kilometer. Two life-history characteristics, development time and starvation resistance, were measured for both types using standardized methods in a common laboratory environment in the F_3 generation (for details, see van der Linde and Sevenster, 2006). The average values for development time and starvation

resistance were for the 'Type A' strain 8.74 days and 3.34 days, respectively. The estimates for the sympatric secondary forest population of *D. sulfurigaster* were 10.08 days and 2.79 days, respectively, a significant difference with 'Type A' for both traits ($p < 0.05$ for each trait). At the same time, the variation between populations of *D. sulfurigaster* is not significant ($P = 0.58$ and $P = 0.19$, respectively), and substantially smaller than the differences between these two types (development time: 9.75 -10.08; starvation resistance: 2.79 - 3.18; van der Linde and Sevenster, 2006).

These obvious differences between the two groups raise the question whether these are separate species or represent a single-gene polymorphism. Individuals of the 'Type A' can be crossed without a problem with individuals of a laboratory strain of *D. sulfurigaster* from the Northern Philippines (personal communication Dr. Y. Fuyama). Unfortunately, various crosses between the different taxa in the *D. nasuta* species subgroup produce F_1-offspring, despite that they are morphologically indistinguishable. One example consists of *D. nasuta* and *D. albomicans* that differ only in karyotype (Wilson *et al.*, 1969; Wakahama and Kitagawa, 1972), but they mate freely with each other and produce fertile F_1 progeny but their F_2 progeny is not. When either *D.* taxon F from Malaysia or *D. pallidifrons* from Ponape (with coloration as the 'Type A' individuals) are crossed with *D. sulfurigaster*, the offspring is completely sterile (Wilson *et al.*, 1969; Kitagawa *et al.*, 1982). The lack of offspring would have been a strong argument in favor of two species, but the reverse is not a conclusive argument that the two types are one and the same species.

To conclude, the unidentified 'Type A' clearly differs in coloration (no white on the frons) and life-history traits (shorter development time and longer starvation resistance) from *D. sulfurigaster*. The same difference in coloration pattern has been observed between species of this subgroup but not within a single species. When crossed, they produce F_1-offspring without a problem, which is observed between species of this subgroup. If 'Type A' individuals are variants of *D. sulfurigaster*, the association between life-history traits and coloration suggests a stable single-gene polymorphism with strong pleiotropic effects. Furthermore, this would imply also that the color differences at the frons are not a useful character for the identification of the various species. Further research will be needed to determine whether 'Type A' represents a variant of *D. sulfurigaster* or a separate (and potentially undescribed) species. Regardless whether these two types are color and life-history variants or two different species, the differences between the types provides new clues to the evolution and speciation within this intriguing group of species as well as to the usefulness of color characteristics for the identification of the species.

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